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The Problem of Uncertainty: Institutional Alternatives and Planning Approaches

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1. INTRODUCTION

The growth of uncertainty as an explicit consideration of planners is related to the rise of 'organized complexity' (Mason and Mitroff 1981), and the increasing turbulence of our societies (Emery and Trist 1965; Schon 1971). Increasingly, planners face 'wicked' problems which are complex, interconnected, ambiguous, and conflict-ridden (Mason and Mitroff 1981, 9). Unravelling the tentacles of wicked problems is a near-impossible task, and is severely constrained by availability of finances and time. The result is that planning is often based on subjective assessments of what the nature and dimensions of the problem are, and conflict within the planning process becomes more prevalent.

The subjective aspect of problem identification has several implications. First, it means there is a strong possibility that the wrong problem will be identified (Raiffa 1968; Mason and Mitroff 1981). Solutions to the wrong problem are usually unsuccessful, and produce a loss of confidence in expert planners. Second, there are an increasing number of disagreements over the shape of the problem among experts, and between experts and laypeople. Third, lack of agreement over the problem's shape has significant costs associated with it, such as an overly conservative bias in decision-making, a tendency to undertake only routine problem-solving, and a strong inclination to do nothing (Mack 1971). Finally, the subjectivity inherent in wicked problem identification means there is no scientifically correct answer. Different perceptions of the problem cannot be termed right or wrong based on the scientific evidence, largely because this evidence is absent.

These implications suggest there can be substantial perceptual differences of uncertainty in planning. To a large extent these are not dealt with in technical analyses of uncertainty or risk, but are resolved through political and institutional processes. Compromise is desirable, but the success of various approaches may depend on why the perceptions vary in the first place. This paper examines theoretical perspectives on perceptions of uncertainty, and then assesses the potential of various institutional alternatives and planning processes for coping with these differences.

1.1 Definitions

There are several ways of defining uncertainty. It can be viewed as the complement of knowledge, suggesting a strict, binary division between what is certain and what is not certain.

Much of planning theory that deals explicitly with uncertainty adopts this definition (Mack 1971, Christensen 1985). This dichotomy is erroneous because it assumes that certain knowledge is possible. The numerous philosophical debates on how we know what we know (epistemology), and the complicated nature of wicked problems challenges this assumption. In addition,this dichotomy suggests one either knows or one does not know, and implies that decisions can only be made if one has certainty. This is contrary to the experiences of most decision-makers (March and Simon 1958; Lindblom 1959), who constantly struggle to make choices under conditions of uncertainty. The dichotomy ignores the large grey area populated by different levels of knowing between the opposite poles of full knowledge and no knowledge.

A second way of defining uncertainty is by its source. Friend and Jessop (1969) suggested planning at the local government level faces three types of uncertainty - environmental (UE), value (UV), and related choice (UR). Environmental uncertainty is related to knowledge of present and future events. Value uncertainty is related to appropriate value judgements regarding expected outcomes of choices. Related choice uncertainty derives from imperfect knowledge of decision-making systems' intentions in related fields. This classification corresponded to often heard demands from planners for more research (UE), more policy guidance (UV), and/or more coordination (UR).

Friend and Jessop suggested that classifying uncertainty according to its source may lead to a better understanding of how to cope with that uncertainty, but it may be a false sense of coping. Once again, the concept of wicked problems suggests these types of uncertainties will be present in all problems, complicated by other sources, and difficult to separate. This interrelatedness may increase the subjective nature of the problem definition, and so the possibility that the wrong problem definition becomes the focus of the planning process. However, one positive result of a classification like this is that the perceptions of different participants about uncertainty are reflected in their problem definitions which is an important first step to achieving a compromise definition.

A third way of defining uncertainty is according to the degree of experience possessed regarding the event or phenomenon. Thus true uncertainty describes a situation where there is no previous experience (Knight 1921). Subjectively assessed uncertainty refers to a situation where there is some limited experience, and objectively assessed uncertainty is where there is repeated experience with the event or phenomenon.

The latter classification scheme is similar to distinctions made between uncertainty, subjective risk and objective risk, but risk is usually associated with hazards to health, safety, investments, or the environment, and has strong negative connotations. Uncertainty in planning relates to a broader range of concerns and can be viewed as having a positive as well as negative side. Hertz and Thomas (1984) have argued for a similar interpretation of uncertainty, suggesting the difference between risk and uncertainty used to be described as the difference between attaining and not attaining expert agreement on the probability of an event, i.e. an elusive difference. They argued this is not a valid distinction for practical situations where generally the quality of information available is poor and is underpinned by large measures of discretion both in its generation and its use. Consequently, Hertz and Thomas suggested the concept of risk includes considerable uncertainty about the formulation of the problem, and unpredictability of potential outcomes of decisions.

The concept of probabilities is fundamental to any discussion of uncertainty as probabilities describe the likelihood of an event happening. Probabilities are generated through statistical analyses of data or via experiential knowledge. Probabilities, however, are only one side of the uncertainty coin. The other side is the utility or value placed on potential outcomes (Dowie 1984; Raiffa 1968). Utilities are subjective matters, and the tendency of scientists has been to focus on probabilities, which are more amenable to hard analysis. However, associating uncertainty solely with probabilities is an error.

In this discussion, uncertainty is defined in the three categories of true, subjective, and objective, and each category is comprised of probabilities and utilities with regard to potential outcomes. Planners dealing with wicked problems are usually working under conditions of subjective uncertainty in terms of the nature of the problem and the probabilities and utilities associated with potential outcomes.

The subjective nature of this uncertainty assessment in planning means that large perceptual differences may produce conflict in the planning process. We now turn to an investigation of how and why these perceptual differences arise.

2. DIFFERENCES IN PERCEPTIONS OF UNCERTAINTY

Many assessments of uncertainty profess to be objective and scientific, and complicated statistical methodologies are used to maximize the information gleaned from scanty data bases. Recently the objective nature of these techniques has been questioned (Kasper 1980;

Lowrance 1980), and an increasing amount of attention is being focused on the nature and causes of perceptual differences in the assessment of uncertainty. Dowie (1984) suggested there are two positions on this issue. One position is akin to the arrowed lines shown in Figure 1. While the lines appear to be of different lengths, if they are measured, they are equal. There is an objectively correct answer, and conclusions that one line is longer than another is due to a perceptual bias. The other position might be described by the faces/vase diagram in Figure 2. In this picture, seeing the faces or the vase are equally valid perceptions. There is no objectively correct answer which serves as the reference point to detect bias. These two figures are indicative of two important theories of the source of perceptual differences of uncertainty.

2.1 Psycho-cognitive Theories

An important body of knowledge regarding perceptions of uncertainty explores how people make judgements under uncertainty. The leading scholars in this field, Tversky and Kahneman (1974), suggested people rarely have sufficient information to make objective assessments of the probabilities of potential outcomes, and so use heuristics (rules of thumb) to make subjective judgements. Tversky and Kahneman argued that heuristics may produce systematic biases in people's judgements, and they investigated the nature of bias associated with the heuristic techniques of representativeness, availability, and anchoring.

The representativeness heuristic is used to assess the degree to which an event or phenomenon resembles, causes, or results from another event or phenomenon. Phrased another way, "What is the probability that object A belongs to class B? What is the probability that event A originates from process B? What is the probability that process B will generate event A?" (Tversky and Kahneman 1974, 903). If people judge A and B to be alike, their probability estimates will be high.

The representativeness heuristic can produce biased judgements because:

a) it does not take into account prior probabilities, or the base-rate frequency, of outcomes. For example, people given the proportion of lawyers and engineers in a group, then asked to assess the probability that a description of a person in the group was a lawyer or an engineer, ignored the prior probability information and made their judgement based on how the personality sketch fit with their stereotypes of lawyers or engineers;

b) it ignores the effect of sample size. Probabilities are judged to be the same whether the sample is large or small;

c) it produces misconceptions of chance. People expect a sequence of events generated by a random process will represent all the components of that process, even if the sequence is short. This is also known as the gambler's fallacy in which a long run of red in roulette is believed to increase the probability of a black turning up; and,

d) it is insensitive to the reliability of the evidence, or the expected accuracy of the prediction. For example, people often make judgements about expected corporate profits using description of corporations, despite the fact that there is no evidence suggesting corporate descriptions are reliable indicators of future profits.

The availability heuristic is used when people are asked to assess the frequency of a class or plausibility of an event. The assessment is made according to the ease with which instances or occurrences can be remembered, and this heuristic device can produce relatively good assessments of frequency or probability. However, several factors may lead to biases, such as:

a) when the ease of retrievability is affected by familiarity. An example of this is when a group hears a list of well-known personalities of both sexes, and is subsequently asked to judge whether the list contains more men or women. The result is usually that the sex with the more famous personalities is judged to be most numerous;

b) when the ease of retrievability is affected by salience. For example, one's subjective probabilities of traffic accidents is higher if one has recently been in a car accident than not;

c) when the assessment is affected by the imaginability of frequences or possibilities. If the event is difficult to imagine or construct in one's mind, its frequency may be underestimated, or vice versa; and,

d) when the assessment is affected by whether the event occurs in relation to another. The perceived strength of the associative bond between two events will affect the assessment of the frequency with which two events co-occur.

The final heuristic investigated by Tversky and Kahneman, anchoring, is related to how people assess the probabilities of certain outcomes when they have an initial value to start with, and are then given information which causes them to reevaluate and adjust that initial value. Tversky and Kahneman found that the adjustments were always biased towards the initial value that people were given, and were never sufficient to approach the true value. Additionally, different starting points produced different estimates which were biased toward their starting points. This was true even when the initial value was recognized to be ridiculous, such as when subjects were asked to estimate the percentage of African nations in the United Nations, and obtained their initial estimate from spinning a wheel of fortune numbered between 0 and 100. Final judgements were biased toward the initial value.

Anchoring affects the evaluation of conjunctive and disjunctive events, so that probability will be overestimated for conjunctive events, and underestimated for disjunctive events. Tversky and Kahneman suggested this has particular relevance for planning because it relies on a series of conjunctive events. The overestimation bias will produce unwarranted optimism regarding the success of a plan. Disjunctive events may be relevant to wicked problems, where the likelihood that a change in one of the complex attributes of the problem and its effect on the plan's success might be underestimated.

An important aspect of these heuristics is that people are typically very confident in their judgements. They are generally insensitive to the tenuous nature of the assumptions their judgements are based on and believe their assessments are reasonably accurate. In addition, people believe their estimates are precise, leading them to put very narrow confidence limits aroung their probability estimates. For example, Capen (1979) asked people to give intervals they believed would include the true probability value of some event. He found that, on average, people's intervals did not include the real value 68% of the time. Capen argued that people's overconfidence in their own judgements led them to overestimate the precision of existing knowledge, and contributed to decisions which resulted in unwelcome surprises. The overconfidence and the potential biases in judgemental heuristics are not restricted to laypeople - experts are at least equally susceptible to these cognitive biases in subjective assessments of probabilities.

Tversky and Kahneman's work was directed exclusively at determining how people assessed the probabilities of uncertain events, and suggested that experience plays a vital role in the process. However, they did not address the importance of values assigned to potential outcomes which is the other side of the uncertainty coin. Slovic, Fischoff and Lichtenstein (1980) investigated some of the questions related to the role of values by examining how

people perceive risk, i.e. what other factors make people see longer lines when in fact they are the same. Their early work, (reported in Slovic et al. 1980), suggested there was a marked difference in the perception of risk by laypeople and experts. When they were asked to evaluate the riskiness of a list of technologies and activites, the experts' assessments were closely related to annual death frequencies, but the laypeople's judgements were not. A subsequent survey determined the difference was not due to incorrect knowledge of annual death frequencies on the part of the laypeople, which suggested that laypeople included other factors in their subjective assessments.

Starr (1969) argued that involuntarily imposed hazards were seen as more risky than voluntarily acepted ones. Pursuing this line of reasoning, Slovic et al. (1980) extended their initial work to determine whether involuntariness or other factors would account for the variation between the laypersons' subjective assessment and the annual death frequencies. Their findings suggested dread, familiarity, and catastrophic potential were stronger influences on perceptions than involuntariness. Slovic et al. argued that the influence of these factors might be strongly related to what is emphasized by the media - leading them to overestimate the risks of dramatic or sensational events, and underestimate more common, unspectacular events. While this work has been criticized for not analyzing the probability and outcome halves of the uncertainty puzzle separately (Dowie 1984), it expanded Tversky and Kahneman's studies by suggesting the value assigned to potential outcomes may be more or as important as people's probability estimates in how they perceive uncertainty.

Most of the research reviewed above adopts the perspective of the lines analogy, and assumes there is a correct answer to the perception of uncertainty. The other approach to the question of perceptual differences is the faces/vase analogy which suggests there is no correct perception. Research on this perspective is the subject of the next section.

2.2 Socio-cultural Theories

The major proponents of a socio-cultural approach to the perception of uncertainty are Thompson and Wildavsky (1980), Douglas and Wildavsky (1982), and Rayner (1984). Their arguments suggested that people in different socio-cultural contexts will have different perceptions of uncertainty which are equally valid and cannot be resolved by referring to some objective measure.

Thompson and Wildavsky (1980) argued people can only deal with a small proportion of the proliferating number of uncertainties, and the ones they perceive are determined by their social context and its accompanying 'cosmology' or value-set. According to Thompson and Wildavsky, a person's social context can be described by two characteristics: *groupness* - describing the degree of exclusivity and self-sufficiency, and ranging from individualized to collectivized situations; and *gridness* - describing the degree of internal differentiation, and ranging from egalitarian to hierarchical. In different combinations, these characteristics describe the various contexts and cosmologies individuals experience (See Figure 3).

A culture with high grid, high group characteristics is caste-like or bureaucratic. Individuals in such cultural contexts are subject to many prescriptions or rules, and risk severe sanctions for breaking those rules. The cosmology of this context might be described as ritualism and sacrifice, suggested by phrases like "A place for everything...".

A culture with high group, low grid characteristics is cooperative and sect-ist. Individuals in this context are not guided by many rules, but the group can still impose severe sanctions on its members. The cosmology or particular brand of rationality associated with this cultural context is fundamentalism - "Small is beautiful".

Low group, low grid characteristics describe an entrepreneurial culture where individuals are not subject to cultural rules or sanctions. Pragmatic materialism describes the cosmology of individuals in this context, exemplified by statements like "If I don't do it, someone else will".

The final cultural context is described by high grid, low group characteristics. Individuals in this cultural context are subject to many rules but are not members of any defined, cohesive group. Inconsistent eclecticism describes the particular rationality or cosmology of individuals in this group, often voiced in phrases like "Life is like a lottery".

Thompson and Wildavsky (1980) argued each of these social context/cosmology combinations yields different perceptions of and attitudes towards uncertainty, associated with whether the individual attempts to manipulate her/his environment, or whether she/he concentrates on survival. Thompson and Wildavsky suggested bureaucratic cultures pursue collective manipulation of long and short term uncertainties, attempting to avoid, spread, or control them. Entrepreneurial cultures produce strategies of individual manipulation of uncertainty but the short term is the major focus. Uncertainties are accepted, seen as opportunities, and exploited. Cooperative or sect-ist cultures are concerned with collective survival, particularly in the long term and so uncertainties are associated with that time frame.

However, far from being accepted or controlled, uncertainties are avoided at all costs. The final cultural context, that of the residual members of society, produces concerns about individual survival and an orientation to short term uncertainties. These uncertainties are accepted, but not exploited as opportunities.

Rayner (1984) extended this analysis of socio-cultural differences in the perception of uncertainty by suggesting each culture will adopt different methods of agreeing on uncertainty. In entrepreneurial cultures perceptions are determined using expert judgements and are constrained by a minimum of formal procedures. Calculated risks are incorporated in the decision process and innovative responses to uncertainty emphasized. In bureaucratic cultures, perceptions of uncertainty are routinized by assignment to special bodies or agencies. This routinization leads to a diminished sensitivity to uncertainty. In cooperative cultures, perceptions are agreed upon by concensus, and emphasis is placed on potential negative consequences of uncertainty.

Rayner (1984) emphasized another difference in perceptions of uncertainty by examining the distribution of gains and losses from uncertainty preferred by each cultural type. He argued the entrepreneurial culture prefers the broadest spread of losses, but the narrowest spread of gains, while the cooperative culture prefers the opposite - narrow distribution of losses but broad distribution of gains. Bureaucratic cultures prefer wide distributions of both losses and gains, through institutional mechanisms such as taxation or the provision of goods and services. Rayner did not discuss the residual cultural category.

Socio-cultural theories explaining differences in perceptions of uncertainty support the faces/vase analogy and suggest no perception is inherently or scientifically right or wrong. Certain groups will place a higher value on certain types of uncertainties than others, and so will become more familiar with particular uncertainties than others. Dowie (1984) suggested this socio-cultural approach to explaining perceptual differences does not necessarily refute the work done by scholars like Tversky and Kahneman (1974). Dowie argued that the socio-cultural perspective provides a framework within which the work on cognitive heuristics can fit. So for example, an entrepreneurial culture will place a higher value on short term uncertainties, and individuals within that culture will use representativeness, availability, and anchoring heuristics to assess probabilities of these short term uncertainties. The two approaches to explaining perceptual differences may not be mutually exclusive.

The four cultural types may co-exist in society, and each type has a substantially different perspective on uncertainty. Under these conditions the tendency of decision-makers to view

objective estimates of uncertainty produced by technical experts as more valid than the subjective perceptions of members of the public is an arrogant and unproductive attitude (Kasper 1980). Additionally, the policy of educating the public so that their subjective assessments eventually agree with more objective representations is an approach with a low probability of success, (and a low utility also!). Compromise among various cultural groups is preferable. Compromise is achieved via political-institutional processes and it is to this subject the paper now turns.

3. INSTITUTIONAL ALTERNATIVES FOR COPING WITH PERCEPTUAL DIFFERENCES

The costs of unresolved differences in perceptions of uncertainty can be high, including deterioration in the wisdom, vigour, and effectiveness of decisions (Mack 1971; Ronge 1982). One way of reducing this cost is to improve the mechanisms for resolving these differences and obtaining some compromise position. This section assess the potential of various institutional alternatives to achieve a compromise.

3.1 Current Mechanisms

Current institutional mechanisms rely on the market, the legislature, regulative agencies, or the courts (Hadden 1984). Reliance on the market is the 'do nothing' option for decision makers faced with the difficulties of defining the relevant aspects of uncertainties, assigning probabilities and utilities to potential outcomes, and distributing the benefits and costs associated with varying outcomes. By relying on the market, these issues are theoretically resolved by individuals. People are free to define uncertain problems for themselves, and to choose whether to expose themselves to uncertainties. There are, however, many situations where the market is not an effective institutional mechanism, such as when significant externalities or transaction costs are involved (Rayner 1984; Ronge 1982). In these situations, individuals turn to the state to resolve the uncertainties for them.

Typically, legislative responses to perceptual differences have been construction of risk standards, or delegation of the responsibility for determining a compromise position to committees and agencies. Risk standards are generally based on scientific evidence, and oriented to some acceptable level of uncertainty and risk. These standards allocate gains and losses from uncertainty among societal groups and are consequently the source of considerable

argument and conflict. Combined with the subjective and arguable data supporting the chosen levels, it is perhaps not surprising that politicians prefer to delegate responsibility for taking actions on uncertain problems, and so avoid direct involvement in much of the acrimonious debate surrounding uncertainty and societal risks.

Agencies typically have a large amount of flexibility in their approach to resolving disagreements about uncertainty. They can also adopt a 'do nothing', market-oriented policy, but this has not typically been the case (Hadden 1984). More commonly, agencies try to perfect the market via various strategies. One method is to improve the information available, either by seeking advice or disseminating information (Nelkin and Pollack 1980). Advisory models can be elitist, as in quasi-judicial forums, or participatory, as in public inquiries. In elitist models, experts argue about the facts and submit their resulting expert judgements for consideration by the committee. In participatory models, the general public is invited to submit briefs concerning particular aspects of a problem, and quite often a large emphasis is placed on production and/or analysis of technical data. Information dissemination models can also be elitist or participatory. In elitist strategies, experts determine what information should be disseminated in order to educate the public about uncertainty. Participatory information models seek to involve the public in defining the salient information for achieving an improved understanding (Nelkin and Pollack 1980). Another strategy to perfect the market that agencies may use is to reduce the costs of externalities, often by forcing those responsible to internalize the costs, via mechanisms like pollution taxes. Or agencies may employ non-market solutions such as setting regulations oriented to minimum performance or procedural standards. These are, once again, usually based on scientific, objective analyses. Agencies have considerable flexibility in addressing uncertainty, but generally tend to prefer objective analyses and emphasize the role of science in assessment of uncertainty.

The other currently available institutional mechanism for resolving disagreements over uncertainty is the judicial system. The courts have largely retreated from addressing substantive issues in resolving conflicts, and instead focus on procedural questions (Rowe 1977) such as defining the proper laboratory methods and procedures, and defining the minimum conditions required for adequate notice of intent (Rowe 1977). The substantive questions of what the nature of the uncertainty is, and what the probabilities and utilities of potential outcomes might be or should be, are generally left unaddressed by judicial processes.

The institutional mechanisms reviewed so far are based on the notion that scientific rationality will prevail (Hewitt 1983), which is supported by several institutional myths (Wynne 1982). First is the myth of 'natural concensus' which suggests science will produce

concensus among all parties by finding the truth. This position is supported by the myths of 'instrumental purity' which asserts that facts are outside of and separate from values, and 'active concensus' which suggests scientists arrive at this truth via peer review and organized skepticism. Thus an objective truth is possible and the myth of 'scientific realism' argues only scientists can find this truth because only science understands reality. These myths combine to make the lines analogy most applicable to current strategies for resolving differences in how people perceive uncertainty.

The inability of these institutional strategies to cope with conflicts over uncertainties is becoming widely recognized (Kasper 1980; Ronge 1982; Hadden 1984). The social consensus which formerly allowed governments and their agents to make such decisions for the people is being challenged in a significant way by several social movements (Ronge 1982). The rise of environmentalism, the growing number of arguments for appropriate, manageable technologies, and an increasing antipathy towards social institutions all contribute to a questioning of the existing social order. People no longer appear willing to take decisions as given. New methods of conflict resolution are required that accept the varying socio-cultural perspectives on uncertainty and attempt to find some compromise position.

3.2 Alternatives

A wide range of alternative institutional mechanisms have been proposed to transcend the narrow scientific-technological paradigm underlying past efforts, and integrate a variety of perceptions of uncertainty into the process. Several of these will be briefly outlined below.

One alternative advocates relying more heavily on the market and on insurance strategies, thereby eliminating the need for complex calculations of potential benefits and costs, and for expenditure of social resources on regulatory efforts. For example, products with uncertain consequences could be rated according to how much insurance for potential damages the consumer is purchasing with the product (Howard 1980). Then the decision is left up to the individual and obtaining compromise among various socio-cultural groups is a non-issue. This kind of policy remains inapplicable to many kinds of uncertainties such as those with significant unknown externalities or transaction costs (Rayner 1984), and contributes little to resolving perceptual differences over the nature of the problem.

Another alternative calls for improvements in the process of problem identification. Mason and Mitroff (1981) suggested that methods of dialectics and argumentation can help planners

to systematically analyze facets of uncertainty and elicit the reasons, rationale and assumptions underlying particular perceptions of the problem. They proposed three specific methodologies - strategic assumption surfacing, dialectical debate, and policy argumentation - and argued that, combined with other methods such as simulation modelling, these methods will lead to a better understanding of the nature of the problem and the rationale underlying resulting decisions. Other authors have also identified this conscious and critical evaluation of assumptions as a crucial step in resolving perceptual differences, paving the way to a compromise position (Wynne 1982). However the scale at which processes like these can occur is limited. Mason and Mitroff's methods are oriented to interaction in small policy groups, and may be of questionable utility at the societal level.

A related alternative, but one more closely aligned to the dominant scientific-technological paradigm, is to create specific bodies, such as Science Councils, which would set rules of evidence and resolve the technical, information-oriented disputes (Rushefsky 1984; Nelkin and Pollack 1980). In setting rules of evidence, these agencies would presumably improve the quality of information available on uncertainty, and also improve the comparability of scientific information. This approach reemphasizes the need for peer review processes which test the assumptions underlying the work, the methods employed and the implications of scientific assessments of uncertainty (Raiffa 1982; Lowrance 1980). Some control like this may reduce biases that scientists may have in interpretting the results of their work.[1]

Several assumptions underpin the Science Council alternative, including the idea that technical experts can resolve technical disagreements. It is assumed that scientists can somehow elevate themselves above the emotional fray, separate facts from values, present a unified front on what the truth is, and so restrict the range of disagreements to political rather than technical areas (Rushefsky 1984). These assumptions have been criticized (Hewitt 1983; Wynne 1982; Nelkin and Pollack 1980) and, combined with the elitist, technocratic characteristics of a centralized Council, make this an unsatisfactory alternative in many situations.

Another alternative institutional mechanism for addressing perceptual differences is centred around improved dialogue and face-to-face negotiation (Rushefsky 1984). In processes based on this approach the emphasis is not on divorcing facts from values and obtaining agreement

[1] Raiffa (1982) notes that scientific experts often prejudge the results of decision processes and bias their facts with prudence and conservative notions, because they know their data is imprecise and subject to widely varying interpretations.

on these aspects separately, but on building on areas of agreement to achieve a better understanding of where the differences are. This is the minimum objective of bargaining processes. Going beyond that is to move towards and achieve a compromise position.

Despite the attractiveness of this alternative, it has some significant limitations. One is the assumption that all parties in the controversy are unhappy with present outcomes. This condition is necessary to achieve conditions of participation and good faith in the process; everyone must have something to gain. However, this may not be the case because of the distribution of gains and losses, which seriously imperils the success of the bargaining process. Other familiar limitations are inequality in resources among participants, and the possibility that some people or groups who are affected by uncertainty may not be aware of it and so uninvolved in the process. Perhaps more fundamental limitations are that negotiation assumes that dialogue produces greater understanding among participants and improves the potential for reaching a compromise, and that an agreement reached via this mechanism will be accepted and acted upon by decision-makers. There are many examples of negotiation processes that have not produced greater understanding, and negotiated solutions have been subverted in implementation or simply never implemented. Finally, bargaining processes are usually corporatist, i.e. they do not involve large numbers of participants. This may be because the potential of reaching an agreement declines as the number of participants grow, and that decisions can never integrate all perspectives and satisfy everyone. However, if the objective of the process is to provide an improved understanding of where the differences lie, certainly involving more groups with different viewpoints is preferable to lesser levels of involvement.

Another institutional alternative for coping with perceptual differences is to design policies that are flexible and adaptable (Holling 1978; Clark 1980; Mack 1971). Policies must include feedback processes, and be able to change in response to what is learned from this feedback. One way of achieving this adaptability is to pursue staged decision processes where policies are stretched out over time, and the results of previous stages reviewed and integrated into decisions regarding later stages. Another strategy is to use pilot projects as small-scale experiments to test certain aspects of the uncertainty. And a more familiar strategy is to incorporate simulation modelling and extensive sensitivity analyses into policy analysis,

preferably in a continuing workshop format, to encourage the self-evaluating qualities of adaptive policies.[2]

The institutional alternatives reviewed here all recognize the limitations of using the lines analogy to resolve differences in perceptions of uncertainty. Even the mechanism most similar to this analogy, the Science Council, recognizes the variation in interpretation that scientific facts are open to. However instead of making the leap to the faces/vase analogy, this alternative returns to the notion that some kind of scientific truth is attainable, if only we can remove all those biases when we look for the facts. This mechanism will clearly never be acceptable to cultural groups whose cosmology is not aligned with this perspective.

The other alternatives make a clearer break with the technical/scientific rationality of the lines paradigm, although they advocate widely varying approaches. The market alternative argues individuals must be free to make decisions under uncertainty which suit their own particular cosmologies, and suggests that collective strategies infringe on this fundamental and necessary freedom. The learning alternatives, whether via dialectic dialogue, bargaining, or feedback and adaptation, suggest that the collective action which is often necessary under uncertain conditions need not necessarily impinge on or refute the validity of various perceptions. Despite the limitations of these approaches they represent attempts to transcend the lines perspective on assessments of uncertainty, and offer the most potential for allowing consideration and perhaps integration of a variety of perceptions of uncertainty into planning.

4. PLANNING APPROACHES TO COPING WITH PERCEPTUAL DIFFERENCES

Perceptions of uncertainty in planning are likely to differ not only among planners, but also between planners and clients. It is unlikely these perceptual differences will be resolved by attempts to clarify the facts of the situation, either with respect to the nature and dimensions of the wicked problem under consideration, or the probabilities and utilities that might be

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[2] Mack (1971) has noted that this learning approach requires an organizational setting which stimulates creativity, flexibility, and learning. The beginnings of a movement to this organic type of organization is happening now in the private sector but is as yet restricted to ones who rely on innovation to survive such as General Electric and Honeywell. The public sector has also experimented with this style of organization and matrix hybrids, but remains primarily a bureaucratic mechanistic organization. The organic learning form of organization is, nevertheless, a consistent theme in much of the literature addressing uncertainty, and conversions to this type may grow over the next decade.

assigned to potential outcomes of a given plan. In this closing section some comments will be made on the potential of various approaches to planning, described by the acronym SITAR, to cope with these perceptual differences by producing a compromise position on which further action can be based. The SITAR acronym represents synoptic, incremental, transactive, advocative, and radical approaches to planning. These approaches vary widely and complete descriptions will not be offered here. Comments will be directed exclusively to how each approach suggests a planner might cope with perceptual differences.

The synoptic approach to planning recommends further collection and analysis of scientifically-derived evidence to elucidate the facts surrounding the probabilities of potential outcomes. This approach is essentially the same as that advocated by proponents of the lines analogy, suggesting differences will be resolved and preferences clear once the truth is found and then communicated to all. Efforts to educate the public on the facts regarding uncertainty, and reliance on the experts to provide those facts and the appropriate analyses are directly related to the synoptic approach. If the problem is difficult to define, or fraught with political overtones (what problem isn't?), the synoptic planner retreats from analysis and requests more policy guidance from her/his political masters. Given the distaste of politicians for questions with distributional yet uncertain implications, this guidance is unlikely to be forthcoming and so the synoptic planner is stymied and unable to cope with perceptual differences. The synoptic approach will be useful where the political will is forthcoming and there is a reasonable data base, but these are not the conditions of subjective uncertainty associated with wicked planning problems.

The incremental approach suggests perceptual differences are resolved in the push and pull of the political marketplace by the process of mutual adjustment. Bargaining and negotiation is constantly occurring among the interested parties, and eventually a compromise position is reached. Planners mediate in this process by ensuring there is good faith and good communication among the participants, and equal information available to all. The planner performs technical analyses when required, and proposes creative alternatives to overcome blocks in the process. This planning approach is more amenable to the faces/vase analogy. The fact/value boundary is perceived as more fluid by the incremental than the synoptic planner, but most of the conflict in the process is depicted as value-oriented arguments. This implies that there is a scientific truth, and suggests that the lines analogy is lurking just beneath the surface of an incremental planning approach. In addition, many of the requirements of negotiated compromise - that all parties must be involved and committed, have equal resources, and that there is no manipulation of either the process or the product - apply to this planning approach. These are difficult requirements to satisfy. Nevertheless,

the incremental approach holds substantial promise for coping with perceptual differences, particularly as it facilitates staged decisions with the incorporation of feedback.

The transactive approach to planning emphasizes dialogue between clients and planners as the cornerstone of the process of mutual learning. In this process facts and values are integrated and so made relevant to the particular situation at hand. This approach is definitely aligned with the faces/vase analogy regarding perceptions of uncertainty, but it fails to consider two important points. First, the transactive approach assumes dialogue naturally and inevitably leads to a mutually-agreed upon definition of the problem and some consensus on action. Second, this approach fails to consider that there may be significantly different cultures within a single society, and that these cultural differences may mean there will always be varying perceptions of uncertainty. Dialogue may not be able to overcome these differences to produce a consensus, or it may be questionable whether consensus, and the degree of 'sameness' it implies in human perceptions, is desirable. Conflict can be a good thing if it is directed towards constructive changes.

The advocative approach to planning is conflict-oriented. Recognizing the cultural and cosmological differences in society, and the many inequalities which lend severe imbalances to current processes of conflict resolution, advocacy proposes to resolve perceptual differences via an adversarial, constructively-oriented process of conflict. Challenging the assumptions, rationale and beliefs underlying opposing positions, the advocate planner forces substantive debate regarding the definition of the problem and the utilities of potential outcomes onto the agenda. The limitation of this approach is the nagging question of who is to make the decision once the arguments have been made. The dialectical approach of advocacy planning suggests a synthetic view evolves out of the debate among opposing arguments and that it is the decision-maker's responsibility to formulate this synthesis. However, decision-makers are often unwilling to make these kinds of choices. The inability of the advocative approach to address this crucial question constrains its utility. Another limitation is the scale at which a process like this can occur. Representing multiple viewpoints might make the process unwieldy and incapable of resolution. Also, the tendency of quasi-judicial and judicial process to retreat to an emphasis on procedural issues to the exclusion of substantive questions raises doubts regarding the appropriateness of the courts as a model for resolution of perceptual differences.

The radical approach to planning considers the facts and values in the planning process to be set overwhelmingly in favour of the capitalist class. Cultural cosmological differences are determined by the individual's relationship to the means of production, but policies ignore

these differences and only represent the cosmology of the dominant class. Non-radical planners promote this by failing to challenge the ideology which underlies this system of domination and legitimates the actions of the state. Radical planners attribute perceptual differences to ignorance and recommend educational or participative strategies to defuse conflicts. In terms of the analogies, radical planners argue the world works according to the lines analogy, where the correct length is determined by the capitalist class. The radical planner's alternative is to work for acceptance of the faces/vase analogy, either by working for dramatic change in the system, or by making incremental changes within the system to improve communication and participation. The removal of class domination is the goal. The radical approach suffers a limitation similar to the transactive approach in that it assumes the end result will be a society where everyone's perceptions will be the same because everyone's relationship to the means of production will be the same. Thus in the new society the lines analogy will prevail again. This is an unrealistic assumption because it suggests people will no longer oppress each other once the economic tools for doing so are removed.

Like the various institutional alternatives for coping with different perceptions of uncertainty, the different planning approaches represented by the acronym SITAR present a range of answers to this question. Each approach has only been briefly reviewed here but it is clear that all have certain strengths and weaknesses, and a planner aware of the limitations of each might adaptively blend certain approaches depending on the situation at hand. Combined with an understanding of the sources of perceptual differences and how certain institutional and planning approaches handle these sources, a planner faced with wicked problems might be able to contribute to achievement of compromise and so pave the way to action.

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